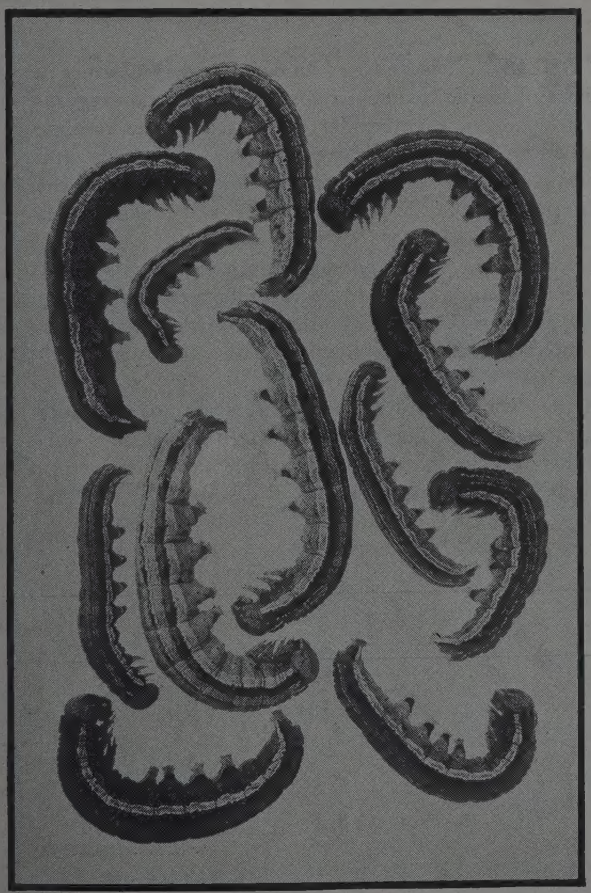
IMP. INST. ENT.
— LIBRARY —
29 OCT 1940
SERIAL U.S.A. 69
SEPARATE

The ARMYWORM AND ITS CONTROL



FARMERS' BULLETIN No. 1850

U.S. DEPARTMENT OF AGRICULTURE

1940

28 370
428

Pa .A.2.U

6 540
722

THIS BULLETIN is designed to convey to the farmer in a brief and simple manner important information regarding the armyworm, a caterpillar which from time to time becomes enormously destructive to growing cereals and sometimes to forage crops, and to urge upon him the necessity for constant vigilance in the war against this insect.

Fields of growing grass and small grain, especially grassy pastures and meadows, should be carefully watched during the spring and early summer months so that the armyworms will be detected before they have a chance to become full-grown and spread over the entire farm.

When the "worms" are discovered at work not a minute should be lost in attacking them by using the measures outlined in this bulletin.

This bulletin supersedes Farmers' Bulletin 731, The True Army Worm and Its Control.

431
1916)

Washington, D. C. Issued April 1940

car. G.M.M.

THE ARMYWORM AND ITS CONTROL

By W. R. WALTON, *senior entomologist*, and C. M. PACKARD, *principal entomologist*, *Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine*

Contents

	Page
Importance	1
Food plants and manner of injury	2
Where invasions of the armyworm come from	2
When invasions may be expected	2
General description	2
Life history	4
The egg stage	4
The caterpillar, or larval stage	5
The pupa, or resting stage	5
The parent, or moth stage	6
History of the armyworm in the United States	6
Insects often mistaken for the armyworm	7
Natural enemies of the armyworm	7
Insect enemies	7
Wild birds and other enemies	8
Controlling the armyworm	8
Importance of early discovery of an infestation	8
Poisoned baits	9
Airplane dusting	10
Mechanical measures	10

IMPORTANCE

THE ARMYWORM (*Cirphis unipuncta* (Haw.)) is probably a native of North America, although it is also found in South America. It occurs throughout most of the United States east of the Rocky Mountains and has also been found in New Mexico, Arizona, and California (fig. 1). It is not known to occur in the Rocky Mountain Plateau region.

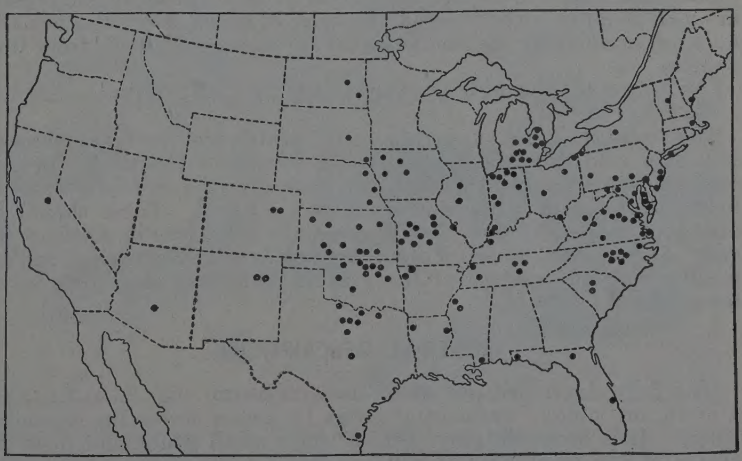


FIGURE 1.—The dots show the localities in the United States in which the armyworm has been destructive.

220153°—40

The loss in money to the farmer through the armyworm in the past has been exceedingly great, and although no exact estimate is possible, it is safe to say that in the Eastern States alone many millions of dollars' worth of grain and forage crops have disappeared down the throats of these pests during the last 30 years.

FOOD PLANTS AND MANNER OF INJURY

By preference the armyworm feeds on grasses, both wild and cultivated; next, on the grasslike grains, such as the several varieties of millet, which suffer severely during outbreaks of the insect. Wheat, corn, oats, and rye are also among its favorite food plants. The armyworm is reported to have injured alfalfa, particularly in the Southwestern States, but under such circumstances that another insect might easily have been mistaken for it.

The armyworm injures crops by eating the tender parts of the leaves, the immature seed, and the sprouts, and, when numerous, it may even devour the plants down to the ground. The more important and by far the most conspicuous injury is always inflicted by the nearly full-grown caterpillar, whose greed and capacity for food are almost unbelievable. The pupa takes no food. The moth subsists principally on the nectar gathered from flowers.

WHERE INVASIONS OF THE ARMYWORM COME FROM

The armyworm usually appears in the fields very suddenly, and it seems certain that the moths at times fly in great numbers for many miles in the direction of the prevailing wind and congregate to deposit their eggs on grasses and small grains which are favorable food plants for their offspring. This would account for the sudden appearance of the armyworm in regions far removed from any known source of infestation. During part of every year the moth seems to be present in small numbers over most of the area in which it occurs, but this does not account for the sudden great invasions that occur from time to time

WHEN INVASIONS MAY BE EXPECTED

Generally speaking, outbreaks of the armyworm are more common following cold, backward springs and should be looked for first in neglected portions of fields in which rank growths of wild grasses or lodged and fallen unripe grains are to be found. These should be examined frequently and closely, especially from late in April to the early part of July, to see if there are any small greenish caterpillars feeding near the surface of the ground under the sheltering, overhanging leaf blades.

GENERAL DESCRIPTION

The fully developed parent of the armyworm (fig. 2, *a;* fig. 3) is a moth, or "miller," measuring about 1½ inches across the expanded wings. It is brownish gray, with a single small white spot near the center of the front pair of wings, the hind wings being somewhat darker along the hind edges. Although these parents of the armyworm sometimes are very numerous, they fly only at night and are

FIGURE 2.—Stages and work of the armyworm and some of its insect enemies: *a*, Parent, or moth; *b*, full-grown larva; *c*, eggs; *d*, pupa in soil; *e*, a parasitic fly, *Winthemia quadripustulata*, laying its eggs on an armyworm; *f*, a ground beetle, *Calosoma calidum*, preying upon an armyworm, and, at right, a *Calosoma* larva emerging from burrow; *g*, a digger wasp, *Sphex* sp., carrying an armyworm to its burrow; *h*, *Enicospilus purgatus*, a wasplike parasite of the armyworm. All about natural size.

therefore often entirely overlooked by the farmer. The stage of the insect most familiar to him is the full-grown, striped, nearly naked caterpillar (figs. 2, *b;* fig. 4), usually discovered in the act of devouring his crops, and in most cases after the greater portion of the infested crop has already been destroyed.

LIFE HISTORY

The armyworm, like many other common insect pests, has four forms, or stages. The parent moths, or millers (fig. 2, *a*; fig. 3), seek out rankly growing grass or grasslike grains such as wheat and oats

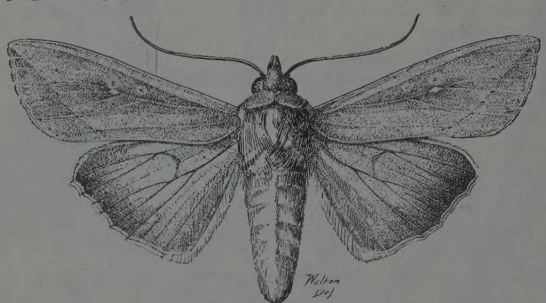


FIGURE 3.—The moth, or parent, of the armyworm. Twice natural size.

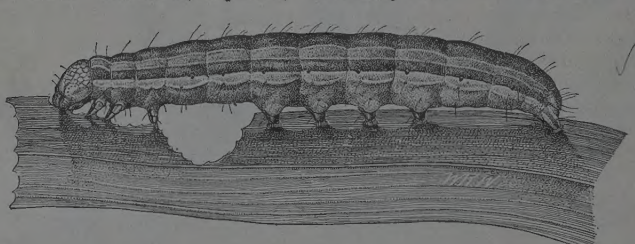


FIGURE 4.—The full-grown caterpillar, or larva, of the armyworm. Twice natural size.

upon which to lay their eggs (fig. 2, *c*). From these eggs hatch little caterpillars, or "worms," which feed and grow rapidly. When full-grown (fig. 2, *b*; fig. 4), the caterpillars shed their skins and change to the brown pupa, or resting stage (fig. 5), usually beneath the surface of the soil (fig. 2, *d*). From these pupae come another generation of parent moths, which in turn mate and lay their eggs, thus providing for another brood of caterpillars. There are usually three broods of caterpillars in any one year, but seldom two successive outbreaks in any given locality.

THE EGG STAGE

The eggs are laid by the parent moths at night, usually in the folded blades or under the leaf sheaths of grains and grasses (fig. 2, *c*). They resemble small white beads, each considerably smaller than the head of a common pin, and are deposited in masses or rows on the plants

selected. Moist or shaded spots usually are chosen for this purpose by the moths, and many moths seem to congregate and lay their eggs in the same locality. In from 8 to 10 days very small greenish caterpillars hatch from the eggs, although extremely high temperatures may greatly shorten this period or low temperatures lengthen it.

THE CATERPILLAR, OR LARVAL STAGE

When the caterpillars are first hatched they are very tiny and, although countless thousands of them may be present, they consume at this time comparatively little food. Feeding near the ground, sheltered from view by the overhanging grain or grasses, they almost invariably escape the notice of the farmer.

As the young worms grow and feed, their skins become too tight for them; so presently they grow a soft, flexible one underneath, shed the old one, and begin feeding more greedily than ever until the new skin has stretched to its limit. This occurs several times during the life of the caterpillar, until it becomes full-grown. The time required for full growth is from 3 to 4 weeks. The full-grown armyworm (cover-page illustration; fig. 2, *b*; fig. 4) is a nearly naked, smooth, striped caterpillar, about 1½ inches long. Its general color is usually greenish, and the stripes, one along each side and a broad one down the center of the back, are dark and often nearly black. The stripe along the back usually has a fine, light-colored, broken stripe running down its center. The color of the body between the dark stripes ranges from greenish to reddish brown. The head is pale greenish brown, finely mottled with darker brown.

FIGURE 5.—The pupa of the armyworm. Twice natural size.

When an army of these worms is at work in a field, the rustling sound of their feeding and other activities can be heard as they greedily devour every blade in sight. In this stage the armyworm frequently consumes all the food supply near the place where it has developed from the egg. When such is the case, the caterpillars crawl away in great numbers in search of other food. It is this habit which has gained for the insect the popular name armyworm. This wholesale migration of the worms affords the farmer an opportunity to destroy them in great quantities by the mechanical methods hereinafter described.

When the full-grown caterpillar ceases feeding, it usually burrows under litter on the ground, under clods, or into the soil to a depth of 2 or 3 inches and by twisting and turning forms a cavity or cell therein. Inside the cell the worm becomes shorter and thicker, after which the skin splits and is shed, and the pupa is formed.

THE PUPA, OR RESTING STAGE

The pupa, or resting stage, of the armyworm is well illustrated in figure 2, *d*, and figure 5. It is at first reddish or chestnut brown, becoming almost black as the time for emergence of the moth approaches. Its skin, or covering, is smooth and tough, and the pupa is unable to move any portion of its body excepting its tail, which it wriggles vigorously on being disturbed. If the soil in which the pupae are

resting is lightly cultivated during this time and the pupae thrown to the surface, most of them will be killed by exposure to the weather, crushed by the cultivating implements, or eaten during the day or at night by skunks, which roam the fields and consume great quantities of such food.

THE PARENT, OR MOTH STAGE

When the moth (fig. 2, *a;* fig. 3) crawls forth from the pupal case it has not yet developed its wings, which are crumpled and folded in padlike masses on each side of its back. It usually crawls up the stem of some plant and begins to expand its wings, waving them back and forth slowly for about an hour; by that time they are completely developed, and the insect is capable of flying. If undisturbed, however, the moths will usually remain at rest for several hours before flying away to mate and lay their eggs. It takes from 7 to 8 weeks for the insect to develop from the egg to the adult, or moth.

After the moths have expanded their wings they do not grow any larger; the small moths are not the young of larger moths but the male moth of the armyworm, which is usually considerably smaller than the female.

The armyworm moth is strongly attracted to lights at night, and frequently large numbers of these moths are seen about outdoor lights shortly before or after an outbreak of the armyworm. Farmers would therefore do well to learn to recognize the moth at sight, as in this way they could be warned of the probable subsequent injurious abundance of the caterpillar. The moths may readily be known by their plain brownish-gray appearance and the presence of a single, very small, almost pure white speck or spot near the center of each of the front wings (see fig. 2, *a*, and fig. 3). The armyworm lives over the winter in the caterpillar stage, and possibly in the pupal stage also, in the Central States, and some evidence has been obtained by the Mississippi State entomologists to indicate that all stages may be present during the winter in the extreme South.

HISTORY OF THE ARMYWORM IN THE UNITED STATES

The armyworm has been known as a serious pest on cereal and forage crops in the United States since early colonial times. In the year 1743 a great outbreak of the armyworm is recorded as having occurred throughout that portion of the country now known as the North Atlantic States. From that time down to the present the insect has hampered agriculture and robbed the farmer mercilessly at comparatively short but irregular intervals. A serious invasion occurred during the summer of 1914, at which time the entire agricultural region east of the Rocky Mountains and north of the Gulf States suffered to a greater or less degree. Extensive and severe outbreaks progressing from the Gulf States to Canada also occurred in 1937, 1938, and 1939. From the past history of the insect it appears that the farmer will undoubtedly be obliged to cope with it from time to time, and he should ever be on the alert during the spring and early summer months to discover and check the pest before it has made serious inroads upon his crops.

INSECTS OFTEN MISTAKEN FOR THE ARMYWORM

The armyworm is often confused in the public mind with the fall armyworm (*Laphygma frugiperda* (A. and S.)), or "grass worm," as it is known in some of the States of the extreme South. The fall armyworm always originates in the South and travels northward as the summer advances. The army cutworm (*Chorizagrotis auxiliaris* (Grote)) also is occasionally mistaken for the armyworm, but it occurs in destructive abundance only throughout the regions west of the Mississippi River.

The variegated cutworm (*Peridroma margaritosa* (Haw.)) often occurs in large numbers along with the armyworm where legumes are present, especially in alfalfa fields containing much grass. This insect, rather than the armyworm, is often responsible for the greater part of the damage to alfalfa and other legumes. Fortunately the two insects can be effectively controlled together by the use of poisoned-bran bait.

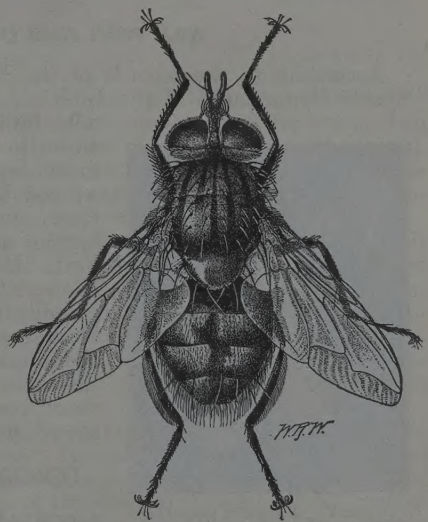


FIGURE 6.—*Winthemia quadripustulata*, a fly parasitic on the armyworm. 5½ times natural size.

NATURAL ENEMIES OF THE ARMYWORM

Fortunately for the farmer, the armyworm has many natural enemies among the native insects, reptiles, birds, and mammals. The termination of an outbreak usually is due to the parasitic and predaceous insects that attack the caterpillars in rapidly increasing numbers as warmer weather becomes more favorable to their activities.

INSECT ENEMIES

One of the commonest and most effective insect foes of the armyworm is a medium-sized, gray fly, *Winthemia quadripustulata* (F.) (fig. 6), closely resembling, and slightly larger than, the housefly. This parasite fastens its eggs to the skin of the caterpillar (fig. 2, *b* and *e*) and the maggots, quickly hatching from these eggs, bore through the skin into the flesh, where they soon devour the entire inside portions of the armyworm's body. These flies multiply rapidly and often become numerous enough to control the armyworm completely in a given locality.

Another very important insect foe is a very small wasplike creature, *Apanteles militaris* (Walsh) (fig. 7), which pierces the caterpillar

with its sting, or ovipositor, laying its eggs inside the armyworm's body, where they quickly hatch, and the maggots, having eaten their fill, bore their way outward and spin little silken cocoons in a mass together, somewhat resembling grains of rice entangled in a mass of cotton. This parasite is also of great service in controlling the pest.

Several other insect enemies serve more or less efficiently in reducing the numbers of the armyworm. Some of these, *Calosoma calidum* (F.), *Sphex* sp., and *Enicospilus purgatus* (Say), are shown in figure 2, *f*, *g*, and *h*.

WILD BIRDS AND OTHER ENEMIES

According to the records of the Biological Survey of the United States Department of the Interior, more than 40 species of native wild birds are known to eat the armyworm in its various stages. Among the most important of these are the red-winged blackbird, purple grackle, robin, crow, yellow-headed blackbird, grasshopper sparrow, song sparrow, and cowbird. Domestic fowls of all kinds, if allowed to roam over infested fields, will greedily devour the caterpillars and pupae. Skunks and toads also undoubtedly eat thousands of the caterpillars and pupae. All these enemies of the pest should be encouraged and protected by the farmer by all possible means.

FIGURE 7.—Larva of the armyworm surrounded by silken cocoons of the wasplike parasite *Apanteles militaris*. About natural size.

CONTROLLING THE ARMYWORM

IMPORTANCE OF EARLY DISCOVERY OF AN INFESTATION

The importance of watchfulness on the part of the farmer in combating the armyworm cannot be too greatly emphasized. On the discovery of the pest in its younger stages depends very largely the possibility of stamping out an infestation before serious injury has occurred. Early in the morning or late in the evening, during the spring and early summer months, the farmer should examine his fields of small grain, grass pastures, and meadows frequently, particularly those fields planted to timothy, bluegrass, and especially millet. He should not be satisfied with looking merely at the surface of the stand—the thicker and longer the growth, the greater the danger from the armyworm. To find the small, greenish caterpillars, he should part the grass or grain with the hands in various parts of the field and closely examine the lower portions of the growth, especially that next to the ground around the bases of the plants, under which the armyworms hide during the day. If the caterpillars are found in any number, the area covered by the infestation should be determined and vigorous action taken at once to destroy them before they become large enough to begin their journey to other parts of the

farm. If the infested spot is small they can be destroyed by mowing off the grass or grain, scattering straw over the spot, and burning it.

POISONED BAITS

Poisoned baits have long been used as a means of destroying many different species of cutworms and also the armyworm. The thorough application of a good bait is usually the quickest, cheapest, and most effective method of control. An efficient bait of this kind may be prepared and used as follows:

Formula

Wheat bran	pounds	100
Paris green or white arsenic	do	4
Water	gallons	12

Mix the poison and the bran thoroughly together in a dry state, then add the water, and stir vigorously until they are thoroughly mixed. Two quarts of liquid sodium arsenite can be used instead of the paris green or white arsenic, in which case it should be stirred into the water instead of into the bran, when the bait is being prepared.

Broadcast this bait over the infested field, taking care to sow it thinly on the ground in flakes and not in lumps. In case bran cannot be readily obtained, an equal volume of coarse alfalfa meal or cottonseed hulls, coarsely ground or unground, may be successfully substituted for the bran. When these substitutes are used it is necessary to sweeten the bait by thoroughly stirring a gallon of crude cane molasses into the water before mixing it with the bait, in order to make it attractive to the worms.

When properly distributed, the quantity mentioned in the formula is enough to treat 3 to 5 acres. It may be scattered rapidly and satisfactorily by hand, by means of a grain seeder mounted on the rear end of a wagon, or with one of the especially designed bait spreaders now widely used for sowing grasshopper bait. Even in nearly mature grain an end-gate seeder mounted on an ordinary high-wheeled farm wagon may be used for rapid distribution of the bait with surprisingly little damage to the grain as compared with that caused by the worms. This poisoned bait may be used in alfalfa fields and cornfields where it is desired to save the crop for forage purposes, although some temporary injury from burning may result if the bait is scattered too thickly on the plants. Also, when the worms are migrating, a swath of the bait can be spread in front of them with good effect.

For best results the bait should be spread late in the afternoon, since, except on cloudy days, the worms hide under the litter on the ground at the bases of the plants and usually crawl about and feed late in the afternoon and at night.

WARNING: Remember that paris green, white arsenic, and sodium arsenite are violent poisons. Care must be taken to prevent children or other persons, poultry, pets, or livestock of any kind from gaining access to the poison or to the receptacles containing the poisoned bait or used in mixing it. The best way to dispose of any surplus bait is to broadcast it thinly on the ground in a field.

The poison is likely to burn the hands somewhat or cause soreness under the fingernails as a result of mixing and handling the bait. To

avoid this, thoroughly grease the hands with petrolatum or cup grease, working it well under and around the fingernails.

AIRPLANE DUSTING

Although the application of arsenical dusts by means of an airplane is considerably more expensive and frequently less effective than the use of poisoned baits, airplane dusting of small grains has been practiced extensively in the South with fair success where adequate quantities were applied under favorable dusting conditions. In that area, experienced pilots and the equipment ordinarily used for dusting cotton are readily available. The rapidity with which dusts can be applied by airplane in the large fields which prevail in many southern localities and the lack of suitable labor for the application of baits tend to make airplane dusting more practical in those localities. Where farm operations are of the more diversified type and fields are smaller, however, baiting is the cheapest, most effective, and most practical method of control.

Calcium arsenate, or calcium arsenate containing a small percentage of paris green, made especially for dusting, has given good results when applied by airplane at the rate of 15 to 30 pounds per acre, according to the thickness and rankness of the grain, the application being made very early in the morning or very late in the afternoon when the air was so still that there was very little drift and when the plants were wet with dew. Failure to secure effective control of the worms frequently occurred, but this was usually due to the use of unsuitable dust, the application of too little per acre, uneven coverage, too much wind, or insufficient moisture at the time of application. No burning of the small grains by these arsenicals was observed.

MECHANICAL MEASURES

In case the worms are not discovered until they have begun to travel in a mass, many of them can often be destroyed by running a furrow or ditch (fig. 8) completely around the infested area. In attempting to cross this the worms will fall into it, and there they can easily be crushed by dragging a log back and forth in the ditch or furrow. Sometimes the furrows are not dragged but are made with the side farthest from the approach of the worms as steep as possible, post holes about 18 inches deep being sunk in the bottom of the furrow at intervals of about 20 feet. The worms will then crawl along the bottom of the furrow and fall into the holes, where they may be destroyed by crushing or by sprinkling them with a little kerosene or other fairly light oil. Sometimes, in extremely hot weather, they die in these holes without any treatment.

FIGURE 8.—A ditch prepared to entrap marching armyworms. Dragging a log back and forth through the ditch crushes the worms that have fallen into it.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	HENRY A. WALLACE.
Under Secretary	CLAUDE R. WICKARD.
Assistant Secretary	GROVER B. HILL.
Director of Information	M. S. EISENHOWER.
Director of Extension Work	M. L. WILSON.
Director of Finance	W. A. JUMP.
Director of Personnel	ROY F. HENDRICKSON.
Director of Research	JAMES T. JARDINE.
Director of Marketing	MILO R. PERKINS.
Solicitor	MASTIN G. WHITE.
Land Use Coordinator	M. S. EISENHOWER.
Office of Plant and Operations	ARTHUR B. THATCHER, *Chief.*
Office of C. C. C. Activities	FRED W. MORRELL, *Chief.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Foreign Agricultural Relations	LESLIE A. WHEELER, *Director.*
Agricultural Adjustment Administration	R. M. EVANS, *Administrator.*
Bureau of Agricultural Chemistry and Engineering.	HENRY G. KNIGHT, *Chief.*
Bureau of Agricultural Economics	H. R. TOLLEY, *Chief.*
Agricultural Marketing Service	C. W. KITCHEN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Commodity Credit Corporation	CARL B. ROBBINS, *President.*
Commodity Exchange Administration	J. W. T. DUVEL, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Farm Credit Administration	A. G. BLACK, *Governor.*
Farm Security Administration	C. B. BALDWIN, *Administrator.*
Federal Crop Insurance Corporation	LEROY K. SMITH, *Manager.*
Surplus Marketing Administration	MILO R. PERKINS, *Administrator.*
Forest Service	EARLE H. CLAPP, *Acting Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Bureau of Plant Industry	E. C. AUCHTER, *Chief.*
Rural Electrification Administration	HARRY SLATTERY, *Administrator.*
Soil Conservation Service	H. H. BENNETT, *Chief.*

U. S. GOVERNMENT PRINTING OFFICE: 1940

For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 5 cents